of an inch in diameter, and from one to three inches in length, with a hole drilled through lengthwise. They represent a money value of from $2.50 to $25.00, according to their length and beauty of finish and coloring. From the hardness of the material and the rough tools with which they are made, their manufacture must require a great deal of time and patience.

While exploring a mound in Contra Costa County several years ago, the writer found the charred remains of a human skeleton some two feet below the original surface of the soil under the mound, and with it a large and elaborately worked pestle, with a number of coins or beads similar to Figure 2, G mixed with red paint, and fragments of others similar to Figure 2, H. The body had evidently been burned with the beads, and the pestle purposely broken into several pieces; nothing else was found with the remains, except fragments of charcoal mixed with the surrounding soil.

The Indian females wear all the money they can command on the occasion of a "big dance" or other public gathering; but during a visit to the Lake country some years since, the writer had an opportunity of examining a common trunk filled with money and ornaments belonging to a squaw, who was married to a white settler (a common occurrence in that country); the inspection was made without the knowledge of the owner, who would probably have objected to it; the larger portion of the contents of the trunk consisted of money like Figure 2, B with a few like Figure 2, H interspersed.

THE PHILOSOPHER'S STONE.[1]

BY WILLIAM E. HAGEN.

A REVIEW of the history of alchemy will show that the effort made by it to produce gold artificially may be understandingly connected with certain phenomena found associated with gold in nature, and which may be reasonably supposed to have suggested such an undertaking.

From the early authors of Hellenic literature investigation first learns of alchemy as a pursuit of man, and as originating in ancient Cushite Arabia, amongst a people who had then been famed for great wealth in silver and gold for many ages, and of

[1] Abstract of a paper read before the Troy Scientific Association, February 21, 1876.

whom we are told that they had possessed the art of making gold from the earliest times. While we may look with wonder at the almost incredible accounts of their wealth, and still doubt the fact of their having made gold artificially, yet we are compelled to accord to them a high state of civilization, and the possession of as much knowledge in metallurgy specially considered as we ourselves own. We must also admit that in this branch of acquired learning they were in some respects our superiors, particularly in the treatment of copper. With all the evidences of their knowledge in this branch of science we may not consistently laugh down the effort made by them to produce gold from other metals, for this problem was suggested to an intelligence in connection with metallurgical operations fully equal to if not superior to our own.

So far as any large accumulation of gold is concerned, we can reasonably infer that its aggregation did not call for any great display of knowledge, for gold is always found in a metallic state, and its melting and working can be performed by the simplest of metallurgical operations. All we have to do to account for such a condition of accumulation is to suppose that some great source of supply existed of which all traces have now disappeared. We know that there were two avenues open for the collection of gold, the Ural Mountains and the sands of Africa. But they were also rich in silver, and to such an extent that they made their household furniture of it, also using it in connection with gold, to form the caps of columns that adorned their homes. Silver, unlike gold, is seldom found in a metallic state, and it is in fact separated from the ore only by a complicated effort of metallurgical chemistry, and one that requires much more than ordinary melting skill.

It was amongst a people thus skilled in the working of metals that something had been found to suggest the idea that gold could be produced by transmutation, and to learn if we can what there is in nature likely to prompt such a problem is the object of the present paper. Gold is ordinarily found in river gravels and sands, as well as at the bottoms of gulches, whence the greater bulk of the gold produced has been obtained. It is usually separated from the lighter sands and gravels by washing, to accomplish which invention has produced about the same appliances the world over.

Placer gold, as alluvial gold is called, is well understood to be not an original condition of the metal, but a secondary one, and one which has found a new place of repose some distance from

the matrix that formerly held it. All alluvial gold has been liberated from the mountain veins by the crumbling and disintegration of the tops of the elevations, and where erosion has taken place, the gold, which is indestructible in nature, has been set free from the original environment in the vein which held it, and by reason of its greater gravity has descended beneath and through the soil upon the mountain-side, along the inclining face of the rocky slope, until it has reached the lower level of the river or gulch bottom. No salts of gold being found in nature, the surface of the metal is always bright and clean, and, being so soft, ductile, and heavy, its particles adhere by contact to form nuggets. Sometimes an interposing shelf or ledge upon the hill-side will arrest and detain the descending particles until aggregations of a larger size are formed. Such places are called pockets. The breaking away of such a shelf, and the subsequent descent of the gold thus aggregated, by means of gravity, to the lower level of the river bed, accounts for the occasional appearance of the large masses of gold found in river bottoms. The particles of metal occurring in the lower portion of the slope will uniformly be coarser than those obtained higher up, from the effects of aggregation in their passage; and they also begin to show the worn appearance of alluvial gold, from having been carried along over the rough surface of the rocky hill-side in their descent towards the river bed.

Supposing some ancient seeker after the precious metal to have exhausted the supply of a locality by washing the gravels and sands of a river bottom, in following up the hill-side the traces of the descending gold, he would in removing the soil eventually reach a place where all signs of gold would have disappeared. At this point, as he exposed the surface of the mountain-side, he would find a vein of quartz; and this at the top would be much decomposed, having a honey-combed or cellular appearance. Adhering to the quartz, and in some of its cells, he would find particles of gold, and as he made an opening into the vein he would expose to view what we term sulphides of iron and copper, as well as cells containing oxides of these metals, and also gold. When he came to deepen the opening upon the vein, all signs of gold would disappear, and he would find nothing but the quartz and accompanying sulphides. He would hardly suppose the latter to be gold, but, as he found the two to be neighbors, he might infer that the one contained the other, and to settle the question he would call into requisition the services of

his melting friend, fire. When the sulphides were heated, they would give off the fumes of sulphur, and would form oxides of iron and copper, which, though he might not recognize them by these names, he would identify as the same substances that he found in the cells of the quartz with the gold. When he came to wash the product that the fire had made from the sulphides, and found there was no gold, he would be much surprised. But his faculties of perception are very keen; he has them to depend upon, and no books or so-called schools of mines to go to for information, and he has learned to study nature by looking at her square in the face. Now we will suppose him, under such conditions of mental capacity, to be examining a piece of quartz in which there are two features of particular interest in this connection, and these features found to consist of two well-defined cubiform cells which have been opened by the fracture of the piece, and which before its rupture were hermetically sealed, and inclosed within the quartz matrix. These cells both appear to have been shaped by the same agency, the crystalline form of the sulphides. One of the cells is filled with the sulphides, the other contains oxides of iron and copper, which he recognizes as the substances produced from this material by the fire; and with them, within the cell, as it appears, is a small aggregation of gold. He properly assumes that the square form of the cells has been given to them by the crystalline form of the sulphides, and that the latter was the first occupant, and made the cell. How did the sulphide get out, so that the gold could move in, when all the approaches to the cell were sealed up by the surrounding quartz matrix? He reasons that since it could not get out, or the gold move in, the former substance and occupant has been changed, and produced the new-comer, gold.

When these phenomena as presented to ancient alchemy are also before us, we, who claim to be much wiser than the old alchemists, have a way of settling the matter; and we proceed to analyze the sulphides, and from them we do get a trace of gold, though not one ten thousandth proportion of the amount existing in the other cell. We have learned that to investigate any chemical fact, we must take nothing for granted if we seek the truth; and right here, when we fancy we have unraveled the whole mystery, we are met with the troublesome query whether the trace of gold that we have found may not be due to a metamorphosis commenced in the one, and completed in the other; for the amount we have found in the one is but a trifle, compared

with that existing in the other. Growing earnest in our perplexity, we again select with care such portions of the sulphides as we may believe to be in a condition of repose, and make several trials more. Some of the selections do contain a trace of gold, and others do not; but whenever we analyze a piece that shows any evidences of oxidation, and ascertain that the quantity of gold found increases in proportion to the progress of the oxidation very rapidly, we come to the conclusion that we are little better off than the ancient alchemist after all, and we have learned to respect his deduction though we hesitate to accept his facts. We are a little too conservative and careful to jump at his conclusion, but we really feel that we do not require much more persuading to adopt his theory, and we are almost ready to believe that gold may exist in nature as the result of the metamorphosis we have been examining and discussing.

Alchemy found out one leading element which it associated with the assumed production, and that is sulphur; so for centuries this substance has been coaxed, wheedled, and implored to do for alchemy what it seemed to do in nature. But all of man's efforts to harness it into the work are futile, and finally the work has been abandoned, but not until the glittering incentive had led alchemy to perform all the drudgery of elementary chemistry.

Various specimens of ore, exhibited by the speaker, from all the different gold-producing areas of this country, exhibit in different degrees the suggestive phenomena described. Interestingly connected with the elucidation of the proposed hypothesis, are two specimens from the same mine in North Carolina, one of them showing the cell formed in a dense mass of the sulphides, and the other a commencement of the assumed evolution. Both of the specimens are fragments of massive sulphides of iron and copper, and within the cell opened by the fracture of the piece is a nugget of gold, surrounded within the cell by the oxides. Upon the other piece, and where the assumed evolution has commenced, the vitreous and glassy surface of the sulphides has been changed, and a thin film of gold coated the crystals. On some of the faces of them, and on such surfaces of the crystals as sloped downwards, the gold has begun the process of aggregation, is thicker at the bottom of the slope than at the top, and when examined with a microscope distinctly exhibits the fact that the film has thickened upon the lower edge of the inclined surface, under the influence of gravity. The average value of these sul-

phides in the gold, as determined by over thirty carefully made assays, was about ten dollars per ton, the selections for assay being made from such material as seemed nearest to a state of repose.

Wherever decomposition had occurred in the deposit, the yield of gold increased at a large ratio. One bushel of the decomposed sulphides, consisting of oxides and gangue, produced, as the writer was informed, over eighteen hundred dollars; this was said to have been found in a small cavity formed in the vein from the decomposition of the sulphides. An examination of the specimen containing the gold shows that the decomposition of the sulphides to form the cell has been in proportion to about nine times the bulk of the gold and oxide occupying the cell.

Careful examination was made of some twenty tons of this ore, to see if any free gold existed in the sulphides, apart from the evidence of decomposition. This ore was all broken up, and a close inspection failed to find any such appearance within it.

All the quartz veins containing gold in the absence of the sulphides, and as occurring in some parts of California and Montana, are of a more recent formation than the others, and if the gold so existing be examined with care, it will be found to contain unmistakable evidences of being water-worn, as if it had been liberated from an older matrix, and had been washed into the crevice with the silicious solution which filled it. Another fact favoring this deduction is that where such veins dip, the gold is nearly all found at the foot wall, and the quartz upon the upper inclined side of the vein is barren.

Amongst other specimens shown to sustain the hypothesis is a piece of baryta or heavy spar. This contains a large nodule of oxide of iron, with a trace of its former existence as a sulphide present in it. The oxide is full of gold, yet there is none in the baryta apart from this connection with the oxide of iron.

A very interesting form of gold is taken from a vein of tough ferruginous aluminous clay existing in various parts of the Southern States. The gold in this deposit is very singularly aggregated, and the metal is not at all worn by attrition, like alluvial gold, but appears in the form of threads, nodules, and cubes, some of the threads being very delicately joined, as if made where it was found and never disassociated from the old connection of the sulphides in the way of the oxidized skeletons of a former crystallization. Masses weighing five pounds have been found in this deposit. Dr. James Crump, of Montgomery County, North

Carolina, had in his possession many curious forms of gold taken from this clay; one particularly so in the fact that it represented a beetle, and this similarity was not one that taxed the imagination at all to see the resemblance. It looked just as though the insect had been entombed in the clay, and the fine particles of gold had insinuated themselves into the cavity, to there aggregate and take the shape of the insect that it displaced, the lines of the sheath upon the back being as plainly delineated as they are upon a real insect. He had also gold in the form of leaves upon the laminæ of slate, where the gold had drifted in between the foliations and taken the place of the cellulose. All the gold found in this clay was of a peculiarly fine quality.

To such as believe in evolution, the hypothesis seems possible, although we know in the laboratory that gold seems the most positively elementary substance of the metallic series. But many are led to believe that matter in the various forms of environment which we dignify with the name of elements has all been evolved from some simple form of substance that once composed the primeval cosmos. It seems to assume no more annihilation of elementary stability to assert that gold is of a derivative origin than it does to believe, as some now do, that bog iron ore (with iron a so-called element) is evolved from the life of the *Gallonella ferruginea.*

RECENT LITERATURE.

GURNEY'S RAMBLES OF A NATURALIST.[1] — Although not specially interested in ornithology, we have been led on from chapter to chapter until all except the special notes, which take up a considerable portion of the book, have been conned over, and we have been led to regard the work as a very pleasant record, by an observing and evidently experienced ornithologist, of travels in some of the most interesting regions of the Old World. Mr. Gurney discovered but one bird absolutely new to Egypt, the lesser white-fronted goose, and this not a "new species." We much relish a foot-note on page 110, in which it is said that "quite seven tenths of the names which have been bestowed on 'new birds' within the last few years have already sunk into synonyms, and the advance of science has thereby been impeded." This evinces sound ornithology in the author! One chapter is mostly devoted to the sacred ibis. An extract will give some idea of the author's style. "Alas! alas!

[1] *Rambles of a Naturalist in Egypt and other Countries.* With an Analysis of the Claims of certain Foreign Birds to be considered British, and other Ornithological Notes. By J. H. GURNEY, JR., F. Z. S. London: Jarrold and Sons. 12mo, pp. 307. For sale by S. E. Cassino, Naturalists' Agency, Salem, Mass.